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ABSTRACT

The aim of this paper is to present a further contribution to the analysis of absolute convergence, associated with the neoclassical theory, of the manufactured industry productivity at regional level and for the period from 1995 to 1999. This work aims, also, to test the Verdoorn Law, with the alternative specifications of (1)Kaldor (1966), for the five Portuguese regions (NUTS II), from 1995 to 1999. It is intended to test, yet in this work, the alternative interpretation of (2)Rowthorn (1975) about the Verdoorn's Law for the same regions and period.

Keywords: Verdoorn law; convergence theories; panel data; manufactured industries; Portuguese regions.

1. INTRODUCTION

Kaldor rediscovered the Verdoorn law in 1966 and since then this law has been tested in several ways, using specifications, samples and different periods (3)(Martinho, 2011a). However, the conclusions drawn differ, some of them rejecting the Law of Verdoorn and other supporting its validity. (4)Kaldor (1966, 1967) in his attempt to explain the causes of the low rate of growth in the UK, reconsidering and empirically investigating Verdoorn's Law, found that there is a strong positive relationship between the growth of labor productivity (p) and output (q), i.e. p = f (q). Or alternatively between employment growth (e) and the growth of output, ie, e = f (q).

Another interpretation of Verdoorn's Law, as an alternative to the Kaldor, is presented by (5)Rowthorn (1975, 1979). Rowthorn argues that the most appropriate specification of Verdoorn's Law is the ratio of growth of output (q) and the growth of labor productivity (p) with employment growth (e), i.e., q = f (e) and p = f (e), respectively (as noted above, the exogenous variable in this case is employment). On the other hand, Rowthorn believes that the empirical work of Kaldor (1966) for the period 1953-54 to 1963-64 and the (6)Cripps and Tarling (1973) for the period 1951 to 1965 that confirm Kaldor's Law, not can be accepted since they are based on small samples of countries, where extreme cases end up like Japan have great influence on overall results.

(7)Islam (1995) developed a model about the convergence issues, for panel data, based on the (8)Solow model, (1956).

2. ALTERNATIVE SPECIFICATIONS OF VERDOORN'S LAW

The hypothesis of increasing returns to scale in industry was initially tested by Kaldor (1966) using the following relations:

$p_i = a + bq_i$, Verdoorn law (1)

$e_i = c + dq_i$, Kaldor law (2)

where pi, qi and ei are the growth rates of labor productivity, output and employment in the industrial sector in the economy i.

On the other hand, the mathematical form of Rowthorn specification is as follows:

$p_i = \lambda_1 + \varepsilon_1 e_i$, firts equation of Rowthorn (3)

$q_i = \lambda_2 + \varepsilon_2 e_i$, second equation of Rowthorn (4) where $\lambda_1 = \lambda_2$ e $\varepsilon_2 = (1+\varepsilon_1)$, because $p_i=q_i-e_i$. In other words, $q_i - e_i = \lambda_1 + \varepsilon_1 e_i$, $q_i = \lambda_1 + e_i + \varepsilon_1 e_i$, so, $q_i = \lambda_1 + (1+\varepsilon_1)e_i$.

Rowthorn estimated these equations for the same OECD countries considered by Kaldor (1966), with the exception of Japan, and for the same period and found that ε_2 was not statistically different from unity and therefore ε_1 was not statistically different from zero. This author thus confirmed the hypothesis of constant returns to scale in manufacturing in the developed countries of the OECD. (9)Thirlwall (1980) criticized these results, considering that the Rowthorn interpretation of Verdoorn's Law is static, since it assumes that the Verdoorn coefficient depends solely on the partial elasticity of output with respect to employment.

3. CONVERGENCE MODEL

The purpose of this part of the work is to analyze the absolute convergence of output per worker (as a "proxy" of labor productivity), with the following equation Islam (1995), based on the Solow model, 1956):

$$\Delta \ln P_{it} = c + b \ln P_{i,t-1} + v_{it} \qquad (5)$$

4. DATA ANALYSIS

Considering the variables on the models presented previously and the availability of statistical information, we used the following data disaggregated at regional level. Annual data for the period 1995 to 1999, corresponding to the five regions of mainland Portugal (NUTS II), and for the several manufactured industries in those regions. These data were obtained from the INE (National Accounts 2003).

5. EMPIRICAL EVIDENCE OF THE VERDOORN'S LAW

In Table 1 are the results of an estimation carried out for nine manufacturing industries disaggregated and together, as in the face of data availability (short period of time and lack of disaggregated data for these industries in NUTS III) this is a way to estimate considered the equations for the different manufacturing industries during this period. For the analysis of the data reveals that the values of the coefficients of the four equations are, respectively, 0.774, 0.226, -0.391 and 0.609 (all statistically significant), reflecting the increasing returns to scale increased slightly in this economic sector, i.e. of 2.551 (Table 1) to 4.425.

Table 1: Analysis of economies of scale through the equation Verdoorn, Kaldor and Rowthorn, for nine manufacturing industries together for the period 1995 to 1999 and five in mainland Portugal NUTS II

9 Manufactured Industry Together						
	Constant	**Coefficient**	**DW**	**R^2**	**G.L.**	**E.E. (1/(1-b))**
Verdoorn $p_i = a + bq_i$	0.004 (0.766)	0.774* (20.545)	2.132	0.703	178	4.425
Kaldor $e_i = c + dq_i$	-0.004 (-0.766)	0.226* (6.010)	2.132	0.169	178	
Rowthorn1 $p_i = \lambda_1 + \varepsilon_1 e_i$	0.049* (4.023)	-0.391* (-3.392)	2.045	0.112	132	
Rowthorn2 $q_i = \lambda_2 + \varepsilon_2 e_i$	0.049* (4.023)	0.609* (5.278)	2.045	0.214	132	

Note: * Coefficient statistically significant at 5%, ** Coefficient statistically significant at 10%, GL, Degrees of freedom; EE, Economies of scale.

6. EMPIRICAL EVIDENCE OF ABSOLUTE CONVERGENCE, PANEL DATA

Table 2 shows results also for each of the manufacturing industries of the NUTS II of Portugal, but now for the period 1995 to 1999 (10)(Martinho, 2011b).

Table 2: Analysis of convergence in productivity for each of the manufacturing industries at the five NUTS II of Portugal, for the period 1995 to 1999

Metals industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**

Pooling	1.108* (3.591)						-0.111* (-3.353)	-0.118	2.457	0.384	18
LSDV		1.476 (1.143)	1.496 (1.183)	1.503 (1.129)	1.451 (1.186)	1.459 (1.233)	-0.151 (-1.115)	-0.164	2.424	0.416	14
GLS	1.084* (7.366)						-0.108* (-6.866)	-0.114	2.176	0.724	18
Minerals industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	-0.455 (-1.236)						0.052 (1.409)	0.051	1.601	0.099	18
LSDV		2.158* (2.222)	2.280* (2.265)	2.287* (2.227)	2.194* (2.248)	2.417* (2.306)	-0.221* (-2.192)	-0.250	1.359	0.567	14
GLS	-0.356 (-0.854)						0.042 (1.007)	0.041	1.628	0.053	18
Chemical industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	1.236 (1.026)						-0.115 (-0.966)	-0.122	1.049	0.049	18
LSDV		5.320* (4.493)	5.281* (4.452)	5.447* (4.449)	5.858* (4.711)	5.072* (4.501)	-0.525* (-4.470)	-0.744	2.432	0.702	14
GLS	3.136* (2.532)						-0.302* (-2.477)	-0.360	1.174	0.254	18
Electric goods industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	1.936 (1.289)						-0.196 (-1.271)	-0.218	1.945	0.082	18
LSDV		4.729 (1.504)	4.775 (1.507)	4.818 (1.490)	4.590 (1.463)	4.671 (1.519)	-0.482 (-1.488)	-0.658	2.038	0.342	14
GLS	2.075 (1.299)						-0.211 (-1.283)	-0.237	1.976	0.084	18
Transport equipments industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	2.429* (2.264)						-0.237* (-2.179)	-0.270	1.837	0.209	18
LSDV		8.626* (10.922)	8.647* (10.973)	9.051* (10.924)	8.537* (10.917)	8.356* (10.866)	-0.867* (-10.811)	-2.017	2.000	0.896	14
GLS	3.507* (3.025)						-0.346* (-2.947)	-0.425	1.649	0.326	18
Food industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	0.873 (1.619)						-0.082 (-1.453)	-0.086	2.921	0.105	18
LSDV		-0.516 (-0.300)	-0.521 (-0.308)	-0.532 (-0.304)	-0.425 (-0.259)	-0.435 (-0.268)	0.060 (0.341)	0.058	2.230	0.208	14
GLS	1.027* (4.163)						-0.098* (-3.800)	-0.103	2.251	0.445	18
Textile industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	0.788** (2.048)						-0.080** (-1.882)	-0.083	1.902	0.165	18
LSDV		0.514 (0.261)	0.525 (0.270)	0.515 (0.262)	0.522 (0.272)	0.541 (0.301)	-0.051 (-0.239)	-0.052	1.919	0.167	14
GLS	0.802* (20.052)						-0.081* (-18.461)	-0.085	1.719	0.950	18
Paper industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	0.735 (1.524)						-0.073 (-1.471)	-0.076	2.341	0.107	18
LSDV		5.201 (1.479)	5.454 (1.462)	5.410 (1.467)	5.053 (1.470)	4.970 (1.486)	-0.533 (-1.465)	-0.761	1.939	0.227	14
GLS	0.654* (3.329)						-0.064* (-3.198)	-0.066	2.185	0.362	18
Several industry											
Method	**Const.**	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Coef.**	**T.C.**	**DW**	**R^2**	**G.L.**
Pooling	-0.338 (-0.463)						0.042 (0.531)	0.041	2.651	0.015	18
LSDV		3.734** (1.949)	3.883** (1.962)	3.940** (1.966)	3.817** (1.967)	3.647** (1.934)	-0.402** (-1.930)	-0.514	2.905	0.303	14

GLS	-0.904* (-3.791)		0.102* (4.003)	0.097	1.922	0.471	18

Note: Const. Constant; Coef., Coefficient, TC, annual rate of convergence; * Coefficient statistically significant at 5%, ** Coefficient statistically significant at 10%, GL, Degrees of freedom; LSDV, method of fixed effects with variables dummies; D1 ... D5, five variables dummies corresponding to five different regions, GLS, random effects method.

7. CONCLUSIONS

The results of the estimations made in this period, notes that the manufactured industry provides greater increasing returns to scale.

The signs of absolute convergence are different from one manufactured industries to another, but there is a curious results for the equipment transport industry, because present strong evidence of absolute convergence and we know that this industry is a dynamic sector. In another hand we have the textile industry that we expect find strong signs of absolute convergence, because we know this is a sector with weak dynamics, but we do not see these evidences.

So, we can that the strong increasing returns to scale in the same industries are not enough to avoid the convergence of this industries.

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